

# MAX14950 Evaluation Kit

## Evaluates: MAX14950

### General Description

The MAX14950 evaluation kit (EV kit) provides a proven design to evaluate the MAX14950 quad PCI Express® (PCIe) equalizer/redriver. The device includes a four-level programmable input equalization and an eight-level programmable output deemphasis/preemphasis.

The EV kit PCB comes with a MAX14950CTO+ installed, which is available in a lead(Pb)-free (3.5mm x 9.0mm), 42-pin TQFN package with an exposed pad.

### Features

- ◆ Eye Diagram Test Circuit with SMA Input/Output
- ◆ Calibration Traces Provided
- ◆ Proven PCB Layout
- ◆ Fully Assembled and Tested

Ordering Information appears at end of data sheet.

### Component List

| DESIGNATION | QTY | DESCRIPTION  |
|-------------|-----|--|
| C1–C24      | 24  | 0.22 $\mu$ F $\pm$ 10%, 10V X5R ceramic capacitors (0402)<br>Murata GRM155R61A224K |
| C25–C32     | 8   | 2.2 $\mu$ F $\pm$ 10%, 10V X5R ceramic capacitors (0603)<br>Murata GRM188R61A225K  |
| J1–J28      | 28  | Edge-mount SMA connectors  |
| J29         | 1   | Red multipurpose connector   |
| J30         | 1   | Black multipurpose connector   |

| DESIGNATION | QTY | DESCRIPTION   |
|-------------|-----|---|
| JU1–JU8     | 8   | 2-pin headers   |
| R1–R8       | 8   | 1k $\Omega$ $\pm$ 5% resistors (0603)                           |
| U1          | 1   | Quad PCIe equalizer/redriver (42 TQFN-EP)<br>Maxim MAX14950CTO+ |
| —           | 8   | Shunts (JU1–JU8)  |
| —           | 1   | PCB: MAX14950 EVALUATION KIT+                                   |

### Component Supplier

| SUPPLIER                               | PHONE        | WEBSITE                     |
|--|--------------|-----------------------------|
| Murata Electronics North America, Inc. | 770-436-1300 | www.murata-northamerica.com |

**Note:** Indicate that you are using the MAX14950 when contacting this component supplier.

### Quick Start

#### Required Equipment

- MAX14950 EV kit
- 3.3V, 500mA DC power supply
- Pulse data generator with a minimum frequency of 8GHz (e.g., Agilent 81142A)
- Digital serial analyzer (DSA) sampling oscilloscope with a minimum frequency of 12GHz (e.g., Tektronix DSA8200)
- Two pairs of 50 $\Omega$  SMA cables, length matched pairwise

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#### Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation and eye diagram/jitter measurements. **Caution: Do not turn on the power until all connections are completed.**

- 1) Verify that all jumpers are in their default positions (see Tables 1–4).
- 2) Connect the 3.3V, 500mA power supply to the VCC (J29) and GND (J30) connectors on the EV kit.
- 3) Place a shunt across pins 1-2 on jumper JU5 to enable the device.
- 4) Set up the data generator to a bit rate of 8Gbps, with a 1V<sub>p-p</sub> differential voltage and a desired pseudorandom binary sequence (PRBS) or any arbitrary waveform.

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- 5) Use the first pair of SMA cables to connect the differential output signals of the data generator to the IN1P (J3) and IN1N (J4) on the EV kit.
- 6) Use the second pair of SMA cables to connect the two sampling channels of the DSA to OUT1P (J11) and OUT1N (J12) on the EV kit.
- 7) Set the DSA to infinite persistence and select the math function of the signal (OUT1P - OUT1N).
- 8) Adjust the vertical scale to 100mV/div and the horizontal scale to 200ps/div on the DSA.
- 9) Turn on the DC power supply.
- 10) Enable the data outputs on the data generator and autoselect the DSA to observe the waveform from the device.
- 11) Save the waveform on the DSA.
- 12) Disable the data outputs on the data generator.
- 13) Turn off the DC power supply.
- 14) Remove the first pair of SMA cables connected to J3 and J4 on the EV kit and connect them to J17 and J18 on the EV kit.
- 15) Remove the second pair of SMA cables connected to J11 and J12 on the EV kit and connect them to J19 and J20 on the EV kit.
- 16) Enable the data outputs on the data generator and autoselect the DSA to observe the waveform from the calibration through traces.
- 17) Compare the waveform to the waveform that includes the device and observe the jitter/eye height of both systems. Take the difference in jitter/eye height, which is the extra jitter/eye height coming from the device.
- 18) Change the input equalization-control settings and the output deemphasis-control settings for further tests.

### **Detailed Description of Hardware**

The MAX14950 EV kit provides a proven design to evaluate the MAX14950 quad PCIe equalizer/redriver. The device includes a four-level programmable input equalization and an eight-level programmable output deemphasis/preemphasis.

All signal traces coming out of the device are 100 $\Omega$  differential controlled-impedance traces. Once the traces split into separate directions, the traces are 50 $\Omega$  single-ended controlled impedances, which is equivalent to 100 $\Omega$  differentially.

### **Calibration Traces**

At the lower section on the EV kit board are calibration traces that are used as a reference to differentiate the performance of the device from the traces and SMA connectors, providing a complete analysis of the device. For simplicity, only channel 1 is provided with calibration traces. These traces are also intended to be used for the s-parameter extraction of the traces of the DUT for deembedding the trace effect from the performance of the device for a jitter analysis, as well as a serial link data analysis. The jitter performance of a PCIe Gen III transmitter is specified by deembedding the traces to the package pin of the device.

### **Through Traces**

The first calibration traces are made with no load. The lengths of the traces are equal to the channel 1 circuitry minus the device. The traces starting from the SMA connectors are 50 $\Omega$  single-ended controlled impedances. Once the traces run parallel to each other and are matched side by side, the traces are 100 $\Omega$  differential-controlled impedances. The through traces can also be used for measuring the propagation delay and also measuring the exit and entry times of the electrical idle function of the device.

### **Short Traces**

The second calibration traces are shorted at the device's exposed pad. These traces can be used to extract the s-parameters of the traces of the main DUT, along with the use of the open-ended traces and the through traces. They can also be used for the port extension of a vector network analyzer (VNA) (e.g., Agilent Technologies N5230A), along with the open traces.

### **Open Traces**

The third calibration traces are open near the device's exposed pad. These traces can be used to extract the s-parameters of the traces of the main DUT, along with the use of the short-ended traces and the through traces. They can also be used for the port extension of a VNA for calibration, along with the short traces.

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### Jumper Selection

Tables 1–5 show the control settings for the device.

**Table 1. Device Enable Setting (JU5)**

| EN (JU5)   | DESCRIPTION  |
|------------|--------------|
| 0 (Open)*  | Standby mode |
| 1 (Closed) | Normal mode  |

\*Default position.

**Table 2. Input Equalization Setting (JU1, JU2)**

| INEQ1 (JU1) | INEQ0 (JU2) | INPUT EQUALIZATION (dB) |
|-------------|-------------|-------------------------|
| 0 (Open)*   | 0 (Open)*   | 3                       |
| 0 (Open)    | 1 (Closed)  | 5                       |
| 1 (Closed)  | 0 (Open)    | 7                       |
| 1 (Closed)  | 1 (Closed)  | 9                       |

\*Default position.

**Table 3. Output Deemphasis/Preshoot Setting (JU3, JU4, JU7)**

| OEQ2 (JU7) | OEQ1 (JU3) | OEQ0 (JU4) | OUTPUT DEEMPHASIS/PRESHOOT RATIO (dB) |
|------------|------------|------------|---------------------------------------|
| 0 (Open)*  | 0 (Open)*  | 0 (Open)*  | 0                                     |
| 0 (Open)   | 0 (Open)   | 1 (Closed) | 3.5                                   |
| 0 (Open)   | 1 (Closed) | 0 (Open)   | 6                                     |
| 0 (Open)   | 1 (Closed) | 1 (Closed) | 6 (Peak-to-peak swing is 1.2V)        |
| 1 (Closed) | 0 (Open)   | 0 (Open)   | 3.5                                   |
| 1 (Closed) | 0 (Open)   | 1 (Closed) | 6                                     |
| 1 (Closed) | 1 (Closed) | 0 (Open)   | 9 (Peak-to-peak swing is 0.9V)        |
| 1 (Closed) | 1 (Closed) | 1 (Closed) | 9 (Peak-to-peak swing is 1V)          |

\*Default position.

**Table 4. Receiver Detection Input Function Setting (JU5, JU6)**

| RXDET (JU6)         | EN (JU5)   | DESCRIPTION  |
|---------------------|------------|--|
| X                   | 0 (Open)*  | Receiver detection is inactive.  |
| X                   | 1 (Closed) | Following a rising edge of the EN signal, indefinite retry until receiver detected at least one channel. Retry stops a few times after any channel receiver is detected. |
| Rising/falling edge | 1 (Closed) | Initiate receiver detection.   |

X = Don't care.

\*Default position.

**Table 5. Electrical Idle Detection Limits Threshold Setting (JU8)**

| EIVIL (JU8) | THRESHOLD LOW LIMIT (mV) | THRESHOLD HIGH LIMIT (mV) |
|-------------|--------------------------|---------------------------|
| 0 (Open)*   | 108 (typ)                | 115 (typ)                 |
| 1 (Closed)  | 81 (typ)                 | 115 (typ)                 |

\*Default position.

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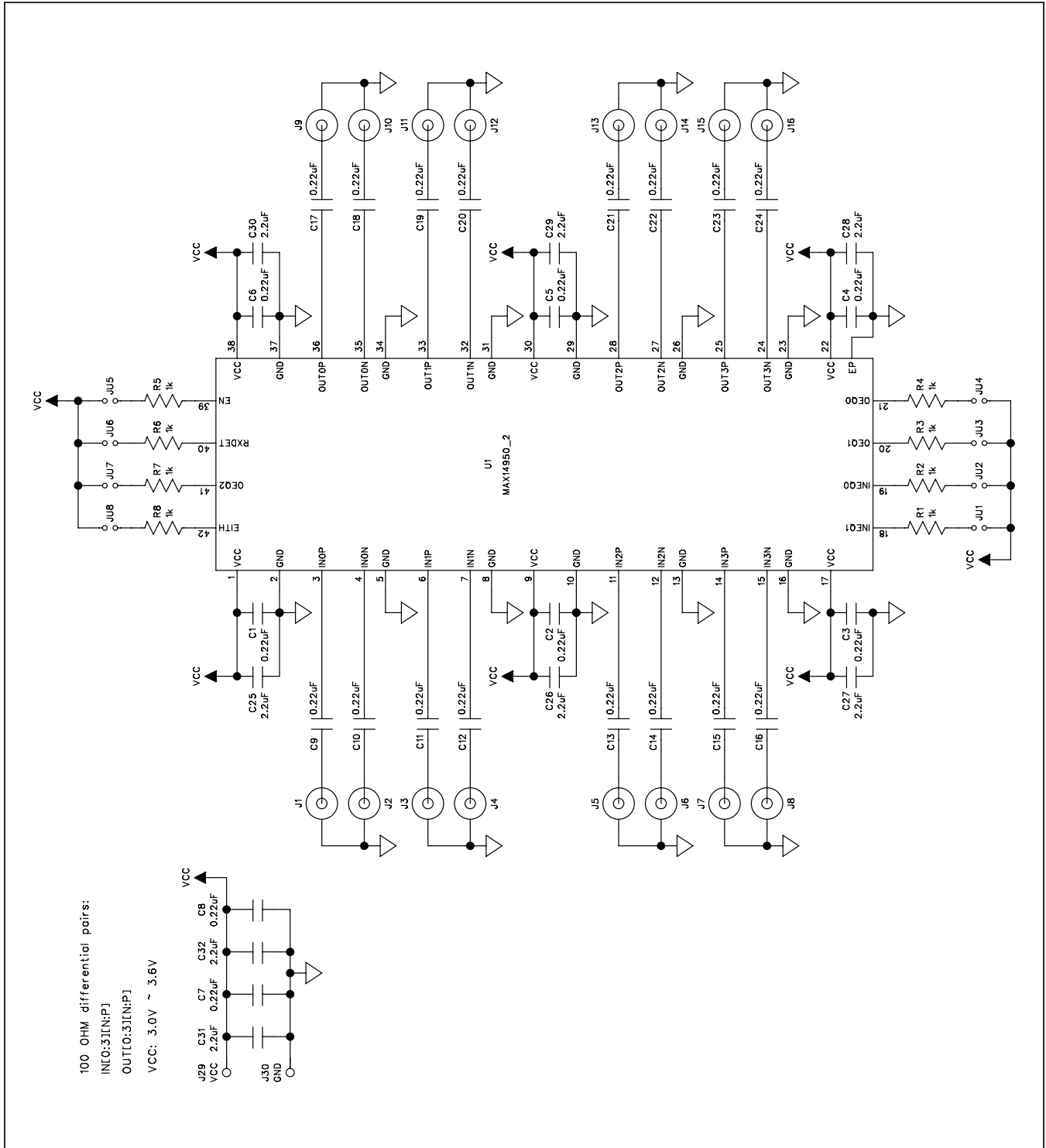


Figure 1a. MAX14950 EV Kit Schematic (Sheet 1 of 2)

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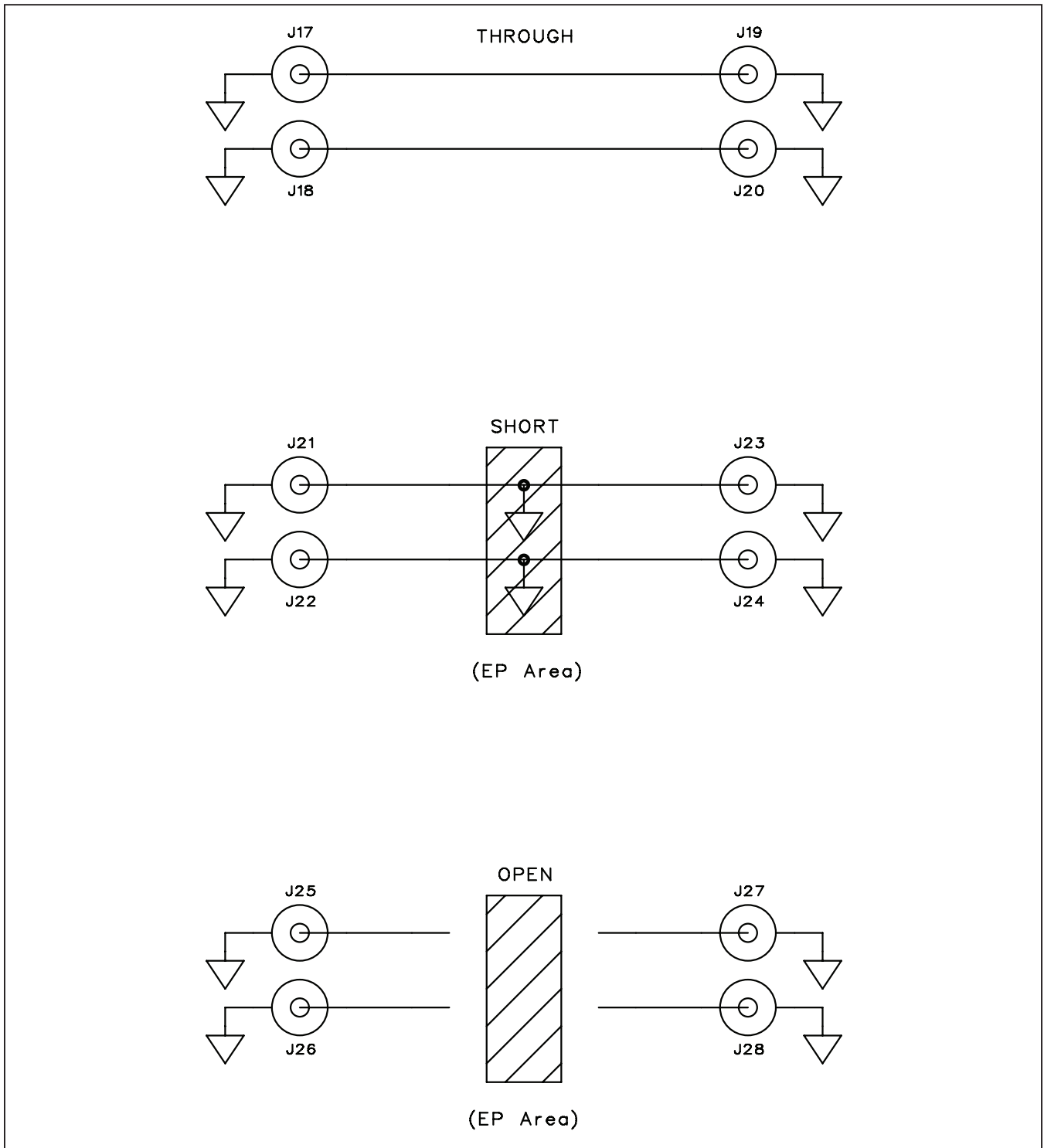


Figure 1b. MAX14950 EV Kit Schematic (Sheet 2 of 2)

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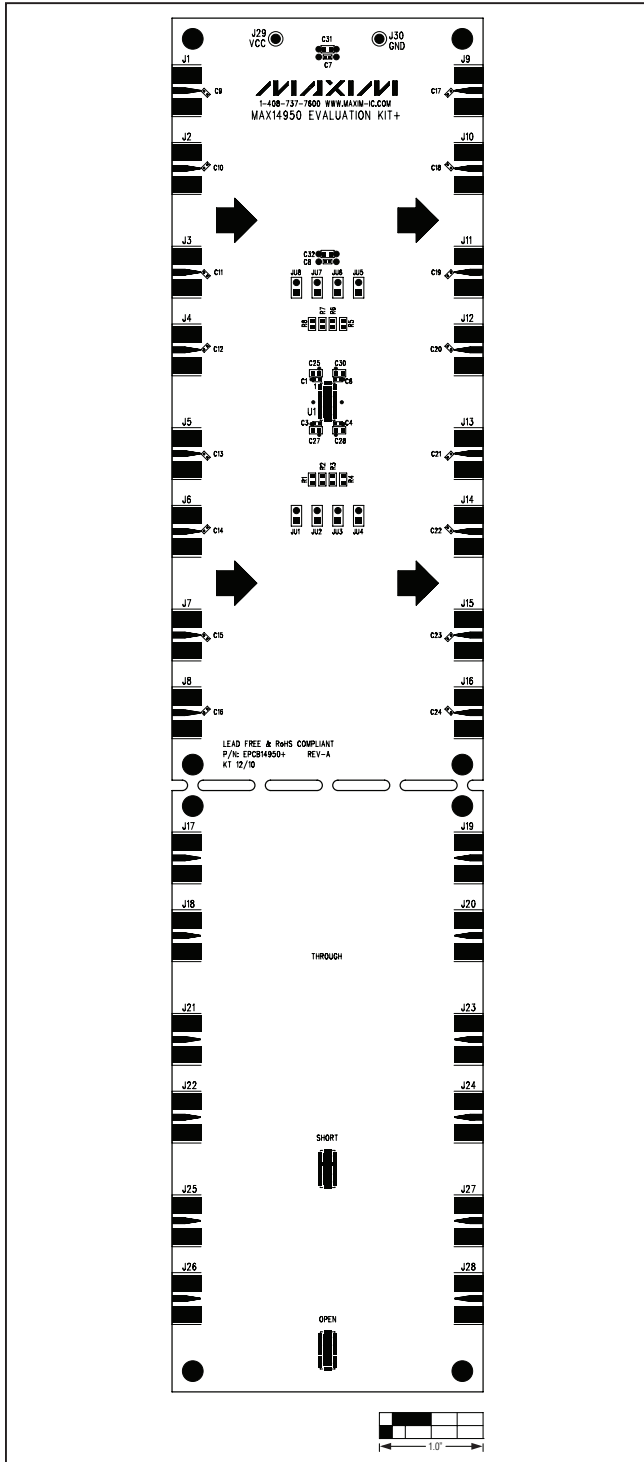


Figure 2. MAX14950 EV Kit Component Placement Guide—Component Side

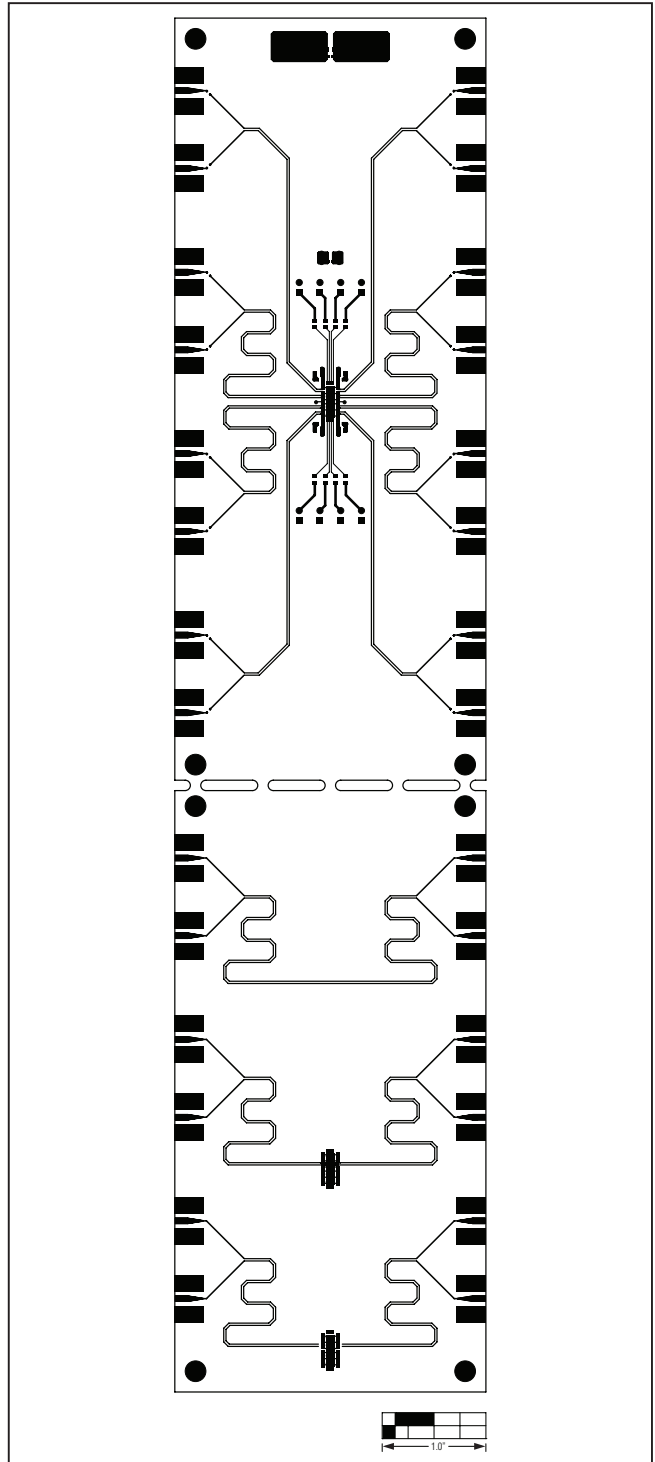


Figure 3. MAX14950 EV Kit PCB Layout—Component Side

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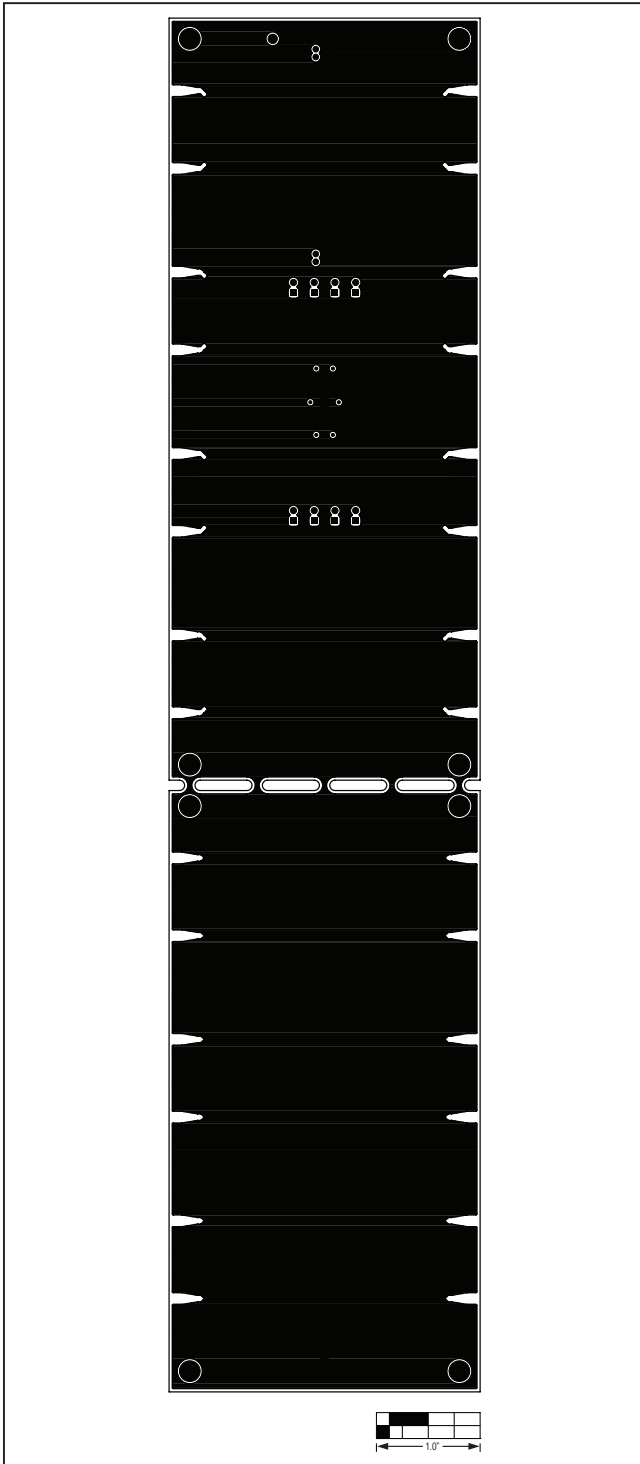


Figure 4. MAX14950 EV Kit PCB Layout— Inner Layer 2

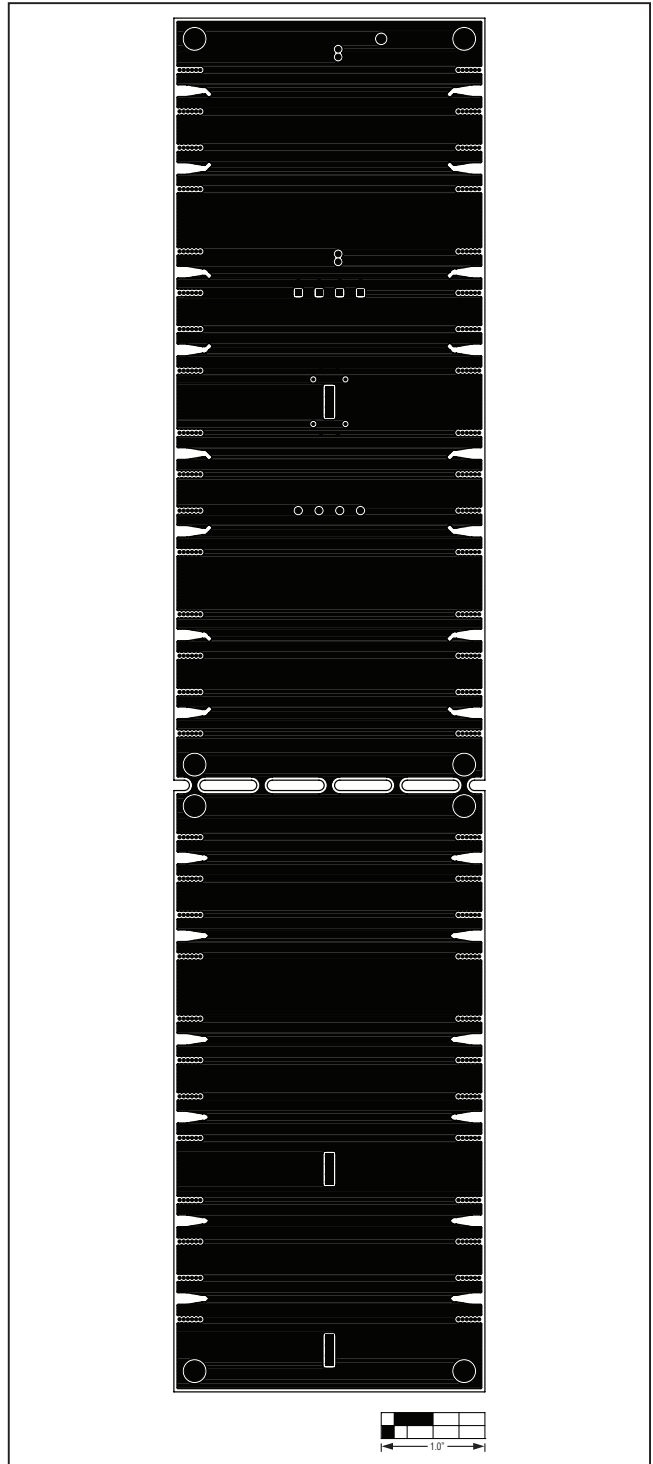


Figure 5. MAX14950 EV Kit PCB Layout— Inner Layer 3

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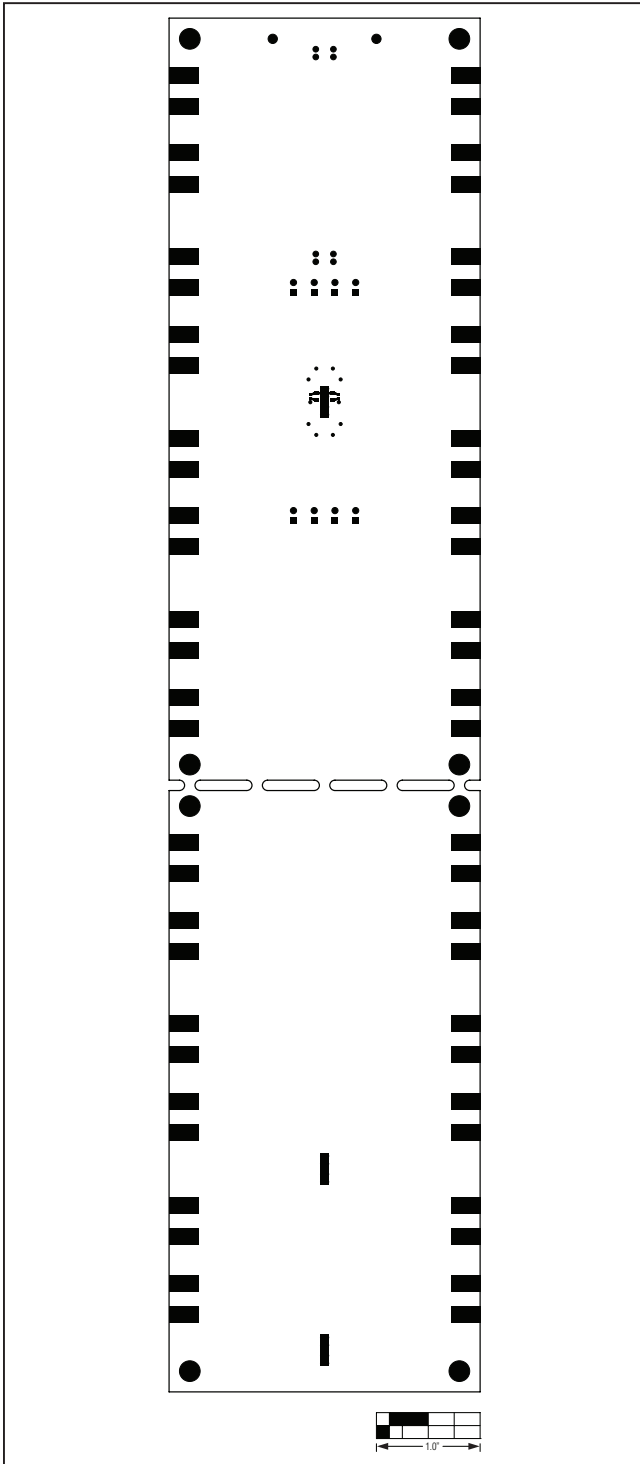


Figure 6. MAX14950 EV Kit PCB Layout—Solder Side

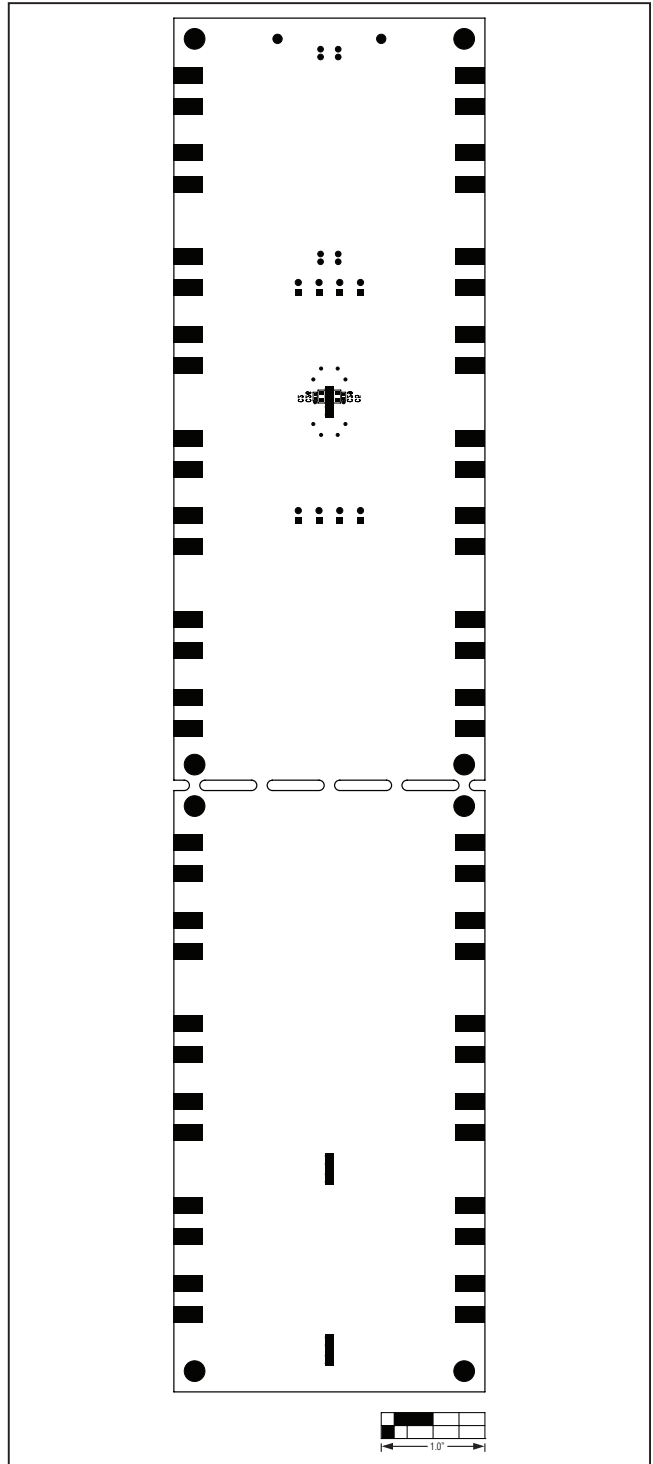


Figure 7. MAX14950 EV Kit Component Placement Guide—Solder Side



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## ***Ordering Information***

| <b>PART</b>    | <b>TYPE</b> |
|----------------|-------------|
| MAX14950EVKIT+ | EV Kit      |

+Denotes lead(Pb)-free and RoHS compliant.

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### *Revision History*

| REVISION NUMBER | REVISION DATE | DESCRIPTION     | PAGES CHANGED |
|-----------------|---------------|-----------------|---------------|
| 0               | 1/11          | Initial release | —             |

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